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Ground beetles (Coleoptera: Carabidae) from rice fields and surrounding grasslands of Northern Iran

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ABSTRACT: Ground beetles (Coleoptera: Carabidae) have an effective role in pest control in rice fields. The fauna of these beneficial insects in the rice fields of Northern Iran (Mazandaran Province) was studied based on sampling (pitfall trap and sweeping net) through 2003-2006. Based on the conducted surveys, 27 species of 19 genera and 12 subfamilies were collected and determined. Among these species, 20 species are newly recorded from Iran. *Harpalus* (*Pseudoophonus*) *rufipes* (DeGeer), *Harpalus* (*Harpalus*) *smyrnensis* Heyden, *Calathus* (*Calathus*) *fuscipes* Goeze and *Scarites* (*Parallelomorphus*) *subcylindricus* Chaudoir are the dominant species in the rice fields and surrounding grasslands.

KEY WORDS: Carabidae, fauna, Iran, new record, rice field.

INTRODUCTION

Rice is the primary food for half the people in the world, providing more calories than any other single food. Several pests cause damage and yield loss on this crop (Datta and Khush, 2002). Arthropods are the main terrestrial invertebrates in rice fields. The arthropod community in rice fields consists mainly of insects and spiders that largely inhabit the vegetation (rice plants and weeds) and soil surface. With respect to rice cultivation and based on the interrelationships between populations, the terrestrial arthropod communities can be further divided into rice pests, their natural enemies (predators and parasitoids) and neutral forms. In rice fields the composition of the terrestrial arthropod communities are known to change with the growth of the rice crop (Bambaradeniya and Amerasinghe, 2003). Although pesticides can control many of the rice pests, because of environmental risks, crop infection and killing of the beneficial insects (natural enemies and pollinators), are not efficient and safe (Khan *et al*., 1991). There are several natural enemies in the rice fields that if conserved, can be effective in decreasing the pest population density (Mohyuddin, 1990; Bonhof *et al*., 1997). Ground beetles (Coleoptera: Carabidae) are one of these efficient predators in rice fields (Heinrichs, 1994; Alonso Mejia and Marquez, 1994).

Ground beetles are one of the largest and most successful families of beetles in the world that arose in the early Tertiary (Desender *et al*., 1994). They comprise more than 40,000 named species, most of which are found in the tropics. More than 30% of the species are arboreal, though in general temperate species are terrestrial, most are also flightless and predatory (Lovei and Sunderland, 1996). Cropping sequence and type of crop influences ground beetle populations. More importantly, pesticides of all kinds reduce to various degrees the number of species and specimens (Stork, 1990).

In Iran, ground beetles are abundant and diverse in agricultural ecosystems (Stork, 1990), but these insects have been studied very poorly (Madarress Awal, 1997; Ghahari et al., 2009). Mazandaran province located south of Caspian Sea (Fig. 1) is the agricultural centre of Iran with rice as the main crop. Although there are several key pests in the rice fields of Mazandaran province, many predators have effective role in controlling these pests. In this research, the Carabidae of rice fields of Northern Iran were studied.

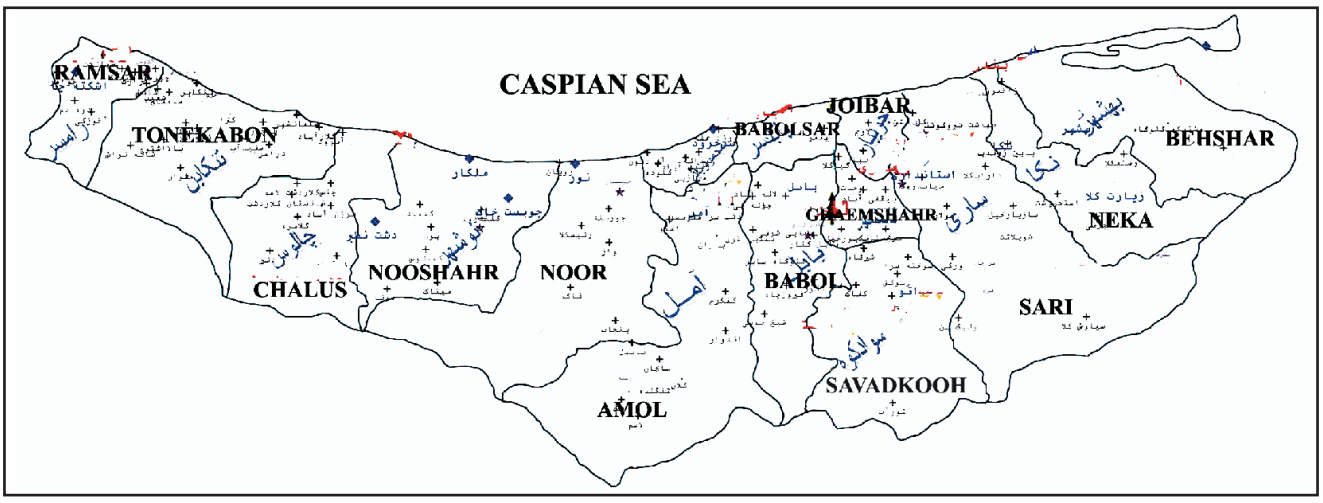

Fig. 1. The map of Mazandaran province, Northern Iran

MATERIALS AND METHODS

Totally 20 plastic pitfall traps (8.5 × 10 cm (diameter × depth)) were installed at 10m intervals in different rice fields and were part filled with ethanol 75%. The traps were emptied weekly for three crop seasons and the fallen beetles were collected and identified. In addition to the pitfall traps, sweepings were conducted randomly in different rice fields and surrounding grasslands of Northern Iran. Also, the specimens of insect collections of Ghaemshahr, Amol and Tehran Islamic Azad Universities were used in this paper too. After collecting the specimens and preliminary identification by the first author, all the materials were sent to Dr. J. Muilwijk of the Netherlands, Dr. O. Hovorka of Czech Republic and the third author for identification or confirmation. All the materials were sent to the mentioned specialists and also Dr. Oldrich O. Hovorka of Czech Republic.

RESULTS AND DISCUSSION

Totally 27 carabid species in 19 genera and 12 subfamilies were collected and identified from the rice fields and surrounding grasslands of Northern Iran (Mazandaran Province). Among the collected species, 20 species (asterisked) are new records for Iranian fauna. Since there are several agricultural pests in Iranian rice fields, especially stem borers and leaf folders, carabids can have an important role in controlling these key pests. The list of carabid species from the rice fields of Northern Iran (Mazandaran Province) is given below.

Family Carabidae
Subfamily Broscinae

****Broscus laevigatus*** (Dejean)
Material examined: Babol (Bandpey), July 2005, 3♀; Noor, September 2005, 2♂.

Subfamily Carabinae

****Calosoma* (*Calosoma*) *inquisitor cupreum*** Dejean
Material examined: Noor, April 2005, 2♂; Nooshahr, July 2005, 1♂, 2♀.
****Calosoma* (*Campalita*) *maderae*** (Fabricius)
Material examined: Behshahr, June 2004, 1♂, 1♀.
****Carabus* (*Mimocarabus*) *roseni*** Reitter
Material examined: Babolsar, September 2005, 1♀; Amol, August 2006, 1♂.

Subfamily Chlaeniinae

****Chlaenius* (*Nectochlaenius*) *canariensis persicus*** L. Redtenbacher
Material examined: Ghaemshahr, October 2004, 1♂, 3♀; Babol (Amir-kola), June 2005, 1♀; Joibar, September 2005, 2♂.

Subfamily Cicindelinae

****Cicindela* (*Cicindela*) *rhodoterena*** Tschitschérine
Material examined: Amol, September 2005, 1♀; Kiakola, April 2006, 2♀.

Subfamily Harpalinae

****Acinopus* (*Acinopus*) *laevigatus*** Ménétriés
Material examined: Behshahr (Rostam-kola), September 2004, 1♀; Joibar, July 2005, 2♂.
Acinopus* (*Acinopus*) *picipes (Olivier)
Material examined: Ghaemshahr, November 2003, 1♂, 2♀; Savadkooh, July 2004, 2♂; Mahmood-Abad, August 2006, 3♀.
****Diachromus germanus*** (Linné)
Material examined: Ghaemshahr, September 2005, 1♂, 3♀; Joibar, June 2006, 2♀.

Harpalus* (*Harpalus*) *smyrnensis Heyden
Material examined: Ghaemshahr, August 2003, 1♂, 2♀; Sari, June 2004, 1♂, 3♀; Savadkooh, September 2004, 2♂, 1♀; Joibar, April 2005, 4♂; Chalus, September 2005, 1♂, 2♀; Babol, May 2006, 2♂.
Harpalus* (*Pseudoophonus*) *griseus (Panzer)
Material examined: Joibar, September 2006, 1♂, 2♀.
Harpalus* (*Pseudoophonus*) *rufipes (DeGeer) = *pubescens* (O. F. Müller)
Material examined: Babol, November 2003, 1♂, 3♀; Babol, August 2004, 4♂, 3♀; Amol, June 2004, 5♂, 2♀; Joibar, August 2005, 5♀; Ghaemshahr, September 2005, 3♂, 4♀; Fereydonkenar, September 2005, 2♂, 2♀; Chalus, July 2005, 3♂, 5♀.

Subfamily Lebiinae

Cymindis* (*Cymindis*) *andreae Ménétriés
Material examined: Sari, August 2005, 1♂, 2♀; Behshahr, September 2005, 2♀; Mahmoodabad, August 2006, 2♂.

Subfamily Nebriinae

Nebria* (*Nebria*) *hemprichi Klug
Material examined: Mahmoodabad, May 2004, 1♂, 2♀.

Subfamily Oodinae

Oodes gracilis A. Villa et G. B. Villa
Material examined: Sari, April 2005, 1♂; Ghaemshahr, July 2006, 2♀.

Subfamily Platyninae

Calathus* (*Calathus*) *fuscipes Goeze
Material examined: Amol, August 2003, 2♀; Mahmoodabad, September 2004, 3♂; Nooshahr, August 2005, 5♂, 3♀; Neka, June 2005, 3♂; Savadkooh, September 2005, 2♀; Joibar, April 2006, 2♂, 4♀.
Calathus* (*Calathus*) *libanensis pluriseriatus Putzeys
Material examined: Savadkooh, November 2005, 1♂, 3♀; Ghaemshahr, September 2005, 2♂.
Laemostenus* (*Sphodroides*) *cordicollis (Chaudoir)
Material examined: Sari, August 2003, 2♀; Neka, June 2005, 2♀.

Subfamily Pterostichinae

Amara* (*Curtonotus*) *convexiuscula Marsham
Material examined: Ghaemshahr (Abdansar), June 2005, 2♀; Sari, October 2005, 2♂.
Poecilus* (*Poecilus*) *cupreus (Linné)
Material examined: Behshahr, July 2004, 1♀; Sari, November 2005, 1♂, 2♀.
Poecilus* (*Ancholeus*) *wollastoni Wollaston
Material examined: Amol, June 2005, 2♂, 1♀; Mahmoodabad, September 2005, 1♀.
Pterostichus* (*Platysma*) *niger (Schaller)
Material examined: Neka, August 2003, 1♂; Sari, September 2005, 1♂, 1♀.
Zabrus* (*Eutroctes*) *aurichalceus (M. F. Adams)
Material examined: Savadkooh (Zirab), August 2003, 2♀.

Subfamily Scaritinae

Scarites* (*Scarites*) *procerus eurytus Fischer von Waldheim
Material examined: Amol, June 2005, 2♀.
Scarites* (*Parallelomorphus*) *subcylindricus Chaudoir
Material examined: Neka, July 2003, 3♂, 1♀; Noor, September 2003, 2♀; Amol, April 2005, 1♂, 4♀; Savadkooh (Shirgah), June 2005, 2♂; Joibar, November 2005, 1♂, 2♀; Babol, August 2006, 3♀; Ghaemshahr (Ahangarkola), September 2006, 4♂, 3♀.
Scarites* (*Parallelomorphus*) *terricola Bonelli
Material examined: Behshahr, October 2003, 1♂, 2♀; Amol, June 2005, 2♂, 4♀.

Subfamily Trechinae

Bembidion* (*Peryphus*) *subcostatum (Motschulsky)
Material examined: Mahmoodabad, August 2003, 1♀; Sari, September 2005, 2♂, Babol, April 2006, 1♂, 2♀.

Among the 27 collected species, four species including *H.* (*Pseudoophonus*) *rufipes*, *H. smyrnensis*, *C. fuscipes* and *S. subcylindricus* are the dominant species in the rice fields and probably have more efficient role in control of rice pests. The subfamilies Harpalinae with 6 species and Pterostichinae with 5 species are the most diverse in the rice fields. The subfamily Harpalinae that underwent an explosive radiation in the Cretaceous period (Ponomarenko, 1989) is the largest group of carabid beetles and includes about 19,000 species (Lorenz, 1998), the bulk of the family's species-level diversity. Iran is a large country incorporating various geographical regions and climates; consequently it would be expected that a large number of additional species remain to be discovered.

Grasslands (in the widest sense) and cereal fields were grouped together by Thiele (1977) as open country, when he listed and ranked the typical carabid species of these habitats; this list was updated in the review of carabids in agriculture by Luff (1987) and for Eastern European crop fields by Lovei and Sarospataki (1990). In northern Europe, there has been much emphasis on their role as predators on aphids in cereals (Sunderland and Vickerman, 1980; Lys and Nentwig, 1991), and the biology of some of the dominant species has been studied (Bilde and Toft, 1994). The carabids of cereals have also been compared with those of other crops, both in terms of their diversity patterns (Booij, 1994)

and species composition (Hance and Gregoire-Wibo, 1987). More recently, however, the actual importance of carabids in pest suppression has been questioned, compared with that of some aphid-specific predators (Winder *et al*. 1994), and the use of carabids in cereals has tended to be seen more in the wider context of their value as indicators of the diversity and 'naturalness' of the agricultural environment. As the biological studies have shown the importance of field margins for carabids (Sotherton, 1985), recent workers have also considered the overall landscape within which the beetle populations exist, and the role of landscape features in enabling their persistence and dispersal (Frampton *et al*., 1995; Mauremooto *et al*., 1995). Rough field margins and hedgerows both increase the overall carabid diversity. The use of artificial 'grass strips' in fields to mimic field boundaries has also been tested (Lys and Nentwig, 1992) and enables overwintering of species that would not otherwise survive within the field itself.

Although cereal fields are only a form of artificial grassland, they differ from most grasslands in two important features: (i) there is drastic soil disturbance during annual cultivations; (ii) there are substantial seasonal changes in soil surface microclimate and availability of prey as the crop grows. Even on a small scale, these differences distinguish the carabid assemblages of grassland and arable land (Carcamo *et al*., 1995). Within grasslands, there is a transition from the fauna of intensively managed agricultural pastures to the 'natural' ground beetle assemblages of semi-natural un-managed grassland and moorland. The carabid assemblages of this range of habitats in northern England can be classified according to site management, soil water and bulk density, and altitude (Luff *et al*., 1992). The responses of individual species to these factors have also been modelled (Rushton *et al*., 1991). Although the role of carabids as pest control agents in grasslands has been considered (Asteraki, 1993), the wider range of habitat types included within the term grassland has led to attempts to use carabid assemblages to characterize these habitats, often as an aid to evaluate their conservation value (Maelfait and Desender, 1990). The biology of many species in managed grasslands has been studied in Belgium, where such work in all agricultural habitats has been reviewed by Alderweireldt and Desender (1994).

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